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Abstract

Twenty ruminally fistulated steers were used in different two experiments to evaluate the effects of supplemental carbohydrate source (starch, glucose, fructose, or sucrose) fed at .3% BW/day on the utilization of low-quality tallgrass-prairie hay. In Experiment 1, all supplemental carbohydrates were fed with a low level of supplemental degradable intake protein. In Experiment 2, the level of supplemental degradable intake protein was high. Intake of the tallgrass-prairie hay was not affected significantly by supplementation in either experiment, but as a result of the added carbohydrate, total intake was increased. When supplemental protein intake was inadequate, supplemental carbohydrates depressed digestion, but when supplemental protein was higher, fiber digestion was not depressed. Because of increased total intake (forage plus supplement) and increased digestion in Experiment 2, total digestible organic matter intake was greater in the supplemented animals, with little difference among carbohydrate sources.

Keywords

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EFFECT OF SUPPLEMENTAL CARBOHYDRATE SOURCE ON THE UTILIZATION OF LOW-QUALITY TALLGRASS-PRAIRIE HAY BY BEEF STEERS

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Summary

Twenty ruminally fistulated steers were used in two experiments to evaluate the effects of supplemental carbohydrate source (starch, glucose, fructose, or sucrose) fed at .3% BW/day on the utilization of low-quality tallgrass-prairie hay. In Experiment 1, all supplemental carbohydrates were fed with a low level of supplemental degradable intake protein. In Experiment 2, the level of supplemental degradable intake protein was high. Intake of the tallgrass-prairie hay was not affected significantly by supplementation in either experiment, but as a result of the added carbohydrate, total intake was increased. When supplemental protein intake was inadequate, supplemental carbohydrates depressed digestion, but when supplemental protein was higher, fiber digestion was not depressed. Because of increased total intake (forage plus supplement) and increased digestion in Experiment 2, total digestible organic matter intake was greater in the supplemented animals, with little difference among carbohydrate sources.

(Key Words: Steers, Forage, Starch, Sugar.)

Introduction

Feeding supplements with a high concentration of degradable intake protein (DIP) has been shown to increase intake and digestion of low-quality forages. In contrast, the effects of feeding large amounts of highly digestible carbohydrate (CHO) may depend on the source of CHO and the amount of DIP provided. Supplemental starch has been shown to decrease the utilization of low-quality forages, whereas nonstarch CHO sources such as fiber and sugars have produced variable results. Our study was designed to provide additional insight into the specific effects of supplemental starch and various sugars, when fed with different amounts of DIP, on intake and digestion of low-quality tallgrass-prairie hay.

Experimental Procedures

Twenty Hereford × Angus steers with ruminal fistulas were housed in individual tie stalls and used in two experiments. In both experiments, steers had free-choice access to low-quality tallgrass-prairie hay (5.2% CP and 72.7% NDF in Exp. 1 and 5.2% CP and 76.0% NDF in Exp. 2). Steers were randomly assigned to treatments at the beginning of each experiment. Treatments were either no-supplement negative control (NC) or supplemental starch, glucose (supplied as dextrose), fructose, or sucrose fed at .30% BW/daily. Sucrose is a disaccharide composed of two monosaccharides, glucose and fructose. We were interested in sugars because of their presence in molasses-based liquid supplements and blocks. Supplemented steers also received degradable intake protein (DIP; sodium caseinate) fed at .031% BW/day in Exp. 1 and .122% BW/day in Exp. 2. Both experiments included a 14-day adaptation period followed by a 7-day intake and fecal collection period. Fecal grab samples were collected every day during the collection period and analyzed for acid detergent insoluble ash, which served as an internal marker to determine total fecal output. Feed offered, feed refused, and fecal output were used to monitor intake response and calculate organic matter (OM) and neutral detergent fiber (NDF) digestibilities.

Results and Discussion

Supplements did not significantly stimulate forage intake compared with the negative control in either experiment (Tables 1 and 2). This was expected when DIP was low (Exp. 1) but not when supplemental DIP was higher (Exp. 2). Because forage intake was similar among treatments, total intake was obviously increased by provision of the supplement.

When limited DIP was provided (Exp. 1), fiber digestion was depressed by supplemental carbohydrate, particularly glucose and sucrose. However, because the supplemental carbohydrate was more digestible than the basal forage, total diet digestibilities for the supple- mented groups did not differ from that of the negative control. In contrast, when a higher level of DIP was fed in Exp. 2, supplemental carbohydrates had no negative effect on fiber digestion. In fact, fiber digestion increased when glucose or fructose was fed. Because fiber digestion was not harmed in Exp. 2, the supplemented groups all had a higher total diet digestion than the negative control.

When the combined effects of intake and digestion were considered, total digestible OM intake increased with carbohydrate supplementation in both experiments. However, little difference occurred among the different carbohydrate sources. In contrast to supplemental DIP, which can stimulate forage intake and digestion, the response to supplemental carbohydrate sources appeared to be limited mostly to the nutrients provided in the supplements themselves.

Table 1. Influence of Supplementation on Intake and Digestibility (Experiment 1)

	Carbohydrates Fed with Low Degradable Intake Protein					
Component	Control	Starch	Glucose	Fructose	Sucrose	SEM
Intake, g/kg $BW^{.75}$						
Forage OM[a]	46.5	54.5	56.1	50.5	52.4	5.13
Total OM	46.5[c]	71.3[d]	72.8[d]	65.8[d]	67.7[d]	5.18
Digestible OM Intake,						
Digestibility, %						
OM	58.7	63.3	58.7	62.6	55.5	3.54
NDF[b]	60.0[d]	52.5[cd]	45.1[c]	52.0[cd]	41.9[c]	4.11

[a] OM = Organic matter.

[b] NDF = Neutral detergent fiber.

[c,d] Least squares means in a row with uncommon superscripts differ ($P \leq .06$).

Table 2. Influence of Supplementation on Intake and Digestibility (Experiment 2)

	Carbohydrates Fed with High Degradable Intake Protein					
Component	Control	Starch	Glucose	Fructose	Sucrose	SEM
Intake, g/kg $BW^{.75}$						
Forage OM[a]	67.1	78.6	76.2	75.8	78.2	4.18
Total OM	67.1[c]	99.6[d]	97.1[d]	95.1[d]	97.6[d]	4.14
Digestible OM intake, g/kg $BW^{.75}$	38.7[c]	66.2[d]	70.9[d]	71.4[d]	66.1[d]	2.52
Digestibility, %						
OM	57.9[c]	66.7[d]	73.1[ef]	75.2[f]	67.7[de]	2.04
NDF[b]	59.3[c]	61.2[c]	68.1[de]	71.3[e]	62.3[cd]	2.41

[a] OM = Organic matter.
[b] NDF = Neutral detergent fiber.
[c,d,e,f] Least squares means in a row with uncommon superscripts differ ($P \leq .06$).